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ling (Carinthia) and from Sarrabus (Sardinia) possess the same chemical composition. The mineral from Lölling, however, crystallizes in the inclined hemihedral division of the regular system, while the Sarrabus occurrence is parallel hemihedral. ——On *barite* crystals from the dolomite, near Volpersdorf, the four new planes $\infty\check{P}5$, $3\check{P}\infty$, $5\check{P}\infty$, and $\frac{1}{4}\check{P}2$ have been detected by Traube.[1]——Patton[2] studies crystallographically the *hornblende*, *oligoclase*, and *titanite* crystals in the druses of the Schrieshiem diorite.——Igelström[3] describes the occurrence of braunite and hausmannite from the Sjögrube, in the Gouvernement of Oerebro, Sweden.——Ch. Lory[4] notes the occurrence of microscopic crystals of *albite* in various limestones and marbles from the Western Alps. Their origin, he thinks, is connected in some way with the specific nature of the calcareous deposits and with the conditions which produced their crystallization.

## BOTANY.[5]

**Character of the Injuries produced by Parasitic Fungi upon their Host-Plants.**[6]—The first and most general injury which is produced upon plants by parasitic fungi results in consequence of the essential character of the fungus. Green plants have the power of converting inorganic materials into food for themselves. Fungi have not this power, but depend for their food entirely upon materials that have been previously elaborated by some green plant. Parasitic fungi take their food from their host while it is yet alive. The consequence to the plant, therefore, is a loss of food, a withdrawal of formed nutritive material, resulting, to greater or less extent, in starvation. In individual cells the contents usually suffer the greater injury, but the wall is also injured, as when penetrated by the haustoria, or suckers,—*e.g.*, upon the mycelium of Peronospora. But the special office of the haustoria is to absorb nutriment from the cell-contents. In some cases, as the above, the cell may live to be the continual prey of the parasite, and in some cases the cell is killed.

(2) While the food-supply of the plant is reduced, its power to replenish it is at the same time impaired,—*i.e.*, in case the fungus grows upon the green parts, as it does most frequently. The passage of light to the cells may be obstructed. The white moulds, or mildews, must obstruct it to some extent, black moulds growing over the surface, much more. The latter may occur either as true parasites, or as saprophytes upon "honey-dew."

Impaired nutrition weakens the physiological power of the chlorophyll. The life of the cells preyed upon is frequently destroyed, and they become brown and dry, as in many species of Septoria, or crumble and fall out, leaving holes in the leaf, as frequently in *Puccinia asteris*. Where the injury is not so severe, spots of various colors, often characteristic of the species, mark more or less definitely the extent of the mycelium. Exposure to light and the activity of the chlorophyll may be lessened in another way, by a change in the position of the infested stems and leaves. A very common effect of a parasite is a more erect and rigid growth, as in blackberries diseased with *Cæoma nitens*, the orange-rust, and in the garden spurges, *Euphorbia maculata* and *E. hypericifolia*, infested with the cluster-cup, *Æcidium euphorbiæ*. These spurges normally grow prostrate, with leaves widely spreading, allowing the greatest possible exposure to sunlight. In the diseased condition the stems are erect and the leaves less favorably spread.

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[1] Neues Jahrb. f. Min., etc., 1887, ii. p. 69.

[2] Ib., p. 261.

[3] Ib., p. 8.

[4] Comptes Rendus, cv., 1887, p. 99.

[5] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

[6] Read before Section F, A. A. A. S., August, 1887.

(3) Growth may be abnormally accelerated or retarded, and both these effects may be produced in different cases by the same fungus. *Peronospora parasitica* growing upon the common peppergrass, *Lepidium virginicum*, forms a thick, felted coating of hyphæ upon the under surfaces of the leaves, and causes the latter to be somewhat contracted. The same fungus growing upon the stems of *Sisymbrium canescens* causes swelling and distortion. The Æcidium on *Sambucus canadensis* distorts the stem by accelerating growth, the infested side becoming swollen and the stem bent.

*Exobasidium vaccinii* on species of Vaccinium causes the leaves to shrink; forms believed to belong to the same species, growing on Azalea and Andromeda, produce inflated sacs, often several inches in diameter.

A distortion usually consists of the fungus producing it and the abnormal tissues of the host, as illustrated in the smut of maize and the curl of peach-leaves. In the latter extra layers of cells are formed on one side.

*Æcidium euphorbiæ* accelerates the growth of the stems of its host and retards that of the leaves,—an effect resembling that of insufficient light upon plants, as upon vines on the shaded side of a trellis, or potato-sprouts in a cellar. The orange-rust on blackberries retards the growth of the leaves, as does also the cluster-cup upon *Ranunculus abortivus*.

Fusicladium, the scab-fungus of apples and pears, retards the growth often of one side, while that of the other continues, producing unilateral development and curvature of the axis of the fruit.

(4) Fungi are not confined to the chlorophyll-bearing parts of plants; woody stems, roots, flowers, seeds, and fleshy fruits all have their parasites. One of the Myxomycetes, *Plasmodiophora brassicæ*, causes the disease called club-root in the roots of cabbage. The appearance of the club-root of roses, which is

troublesome in American green-houses, suggests a similar cause. Among those on woody stems are the black knot on species of Prunus and the Gymnosporangia on cedars.

The flower is attacked in the case of the "double blossom" of blackberries, the smuts of many grasses (such as *Ustilago rabenhorstiana* on *Panicum sanguinale*), and other cases that will suggest themselves. Often the entire inflorescence is arrested in its development. Smut of Indian corn attacks both staminate and pistillate flowers, and the green parts as well. *Ustilago antherarum* upon Caryophyllaceæ produces its spores in the anthers. *Tilletia caries*, the bunt of wheat, destroys the inner structure of the seed, without much changing the external appearance. The majority of Ustilagineæ attack the inflorescence, flowers, and fruit.

The young ovary is affected in various ways. Ergot distorts it and produces an abnormal, horn-like mass of tissue; smuts convert it into powdery spores. Exoascus changes that of Prunus into a pouch. Fusicladium kills the newly-formed pear.

(5) The last case is also an example of the premature falling of diseased parts, apparently by the formation of the separative layer before its time. Such a falling of leaves is well illustrated by *Septoria ribis* upon the currant. On the other hand, diseased parts may remain green after the other parts have matured in the usual way. Ovaries of *Eragrostis poœoides* filled with *Ustilago spermophorus* are most readily detected by this sign. Probably this may be classed as retarded development.

(6) Many fungi cause decay of ripe fruit, both while attached to its plant and after removal, while still alive. From a practical stand-point, the injury to fruit may be of two kinds; it may affect simply the appearance, and hence the market-value, or impair the quality, when it does not entirely destroy. The scab of apples is injurious in either of these degrees.

Some fungi begin their growth as parasites under ordinary conditions, to continue it under conditions more like those which accompany saprophytic growth; in this connection may be mentioned the potato-rot, beginning its growth upon the green plant and sometimes completing it in the cellar, but upon the still living tuber.

(7) Some valuable plants are liable to infection from others of less value; a knowledge of this fact in individual cases may be of great practical utility, as a remedy may be more easily and effectively applied. It is easier to destroy wild grapes and Ampelopsis than to destroy Peronospora upon cultivated grapes which have suffered infection from the wild ones. This remedy especially commends itself when one stage of the fungus grows upon one kind of plant and another stage upon another kind, as do cedar-apples and orchard-rusts.

Perhaps no line of investigation in economic mycology promises better practical results than this. The relations of a few of the Uredineæ are known, as are also the relations of Ustilagineæ and the yeast-like forms which may be looked for in manure; but of the life-histories of the great group of "Fungi imperfecti," including many injurious species, almost nothing is known.

It is often difficult to estimate the extent of the injury to be attributed to any one of these causes, as several commonly operate together. Canada thistle attacked by *Puccinia suaveolens* wilts in hot sunshine, while healthy plants remain fresh; and this appears to be due chiefly to the first cause, the loss of nutriment, which weakens the physiological power. Is it possible that the breaking of the epidermis by the sori, in this or other cases, increases the rapidity of transpiration?

Farmers say the red rust of wheat produces comparatively slight injury, while the black rust is destructive. The black rust appears on the stems, which at that stage of growth have little chlorophyll, even if healthy; the formation of winter spores appears to make a greater drain upon the resources of the host than the formation of summer spores, which have much weaker vitality.

Certain groups of plants are the prey of certain groups of fungi. Gymnosporangia grow upon Cupressineæ; Ræsteliæ upon Pomaceæ; Phragmidia upon the sub-order Rosaceæ proper. Numerous species of Uromyces are parasitic upon Leguminosæ, and the grasses support more Pucciniæ than does any other family of phanerogams. In these two genera no species is known to produce its teleutospores upon host-plants belonging to more than one order. The large majority of Uredineæ grow upon herbaceous plants, as do Ustilagineæ and Peronosporeæ. In these groups a given species commonly inhabits but few species of host-plants, while some Erysipheæ inhabit a large number.

Many Erysipheæ grow upon woody plants. Fungi imperfecti are perhaps least of all to be classified with reference to hosts, though many of their genera may be. Woody plants have fewer active parasites than herbaceous plants. Water-plants and those of wet places are freer from attack than those which grow upon common soil.

To recapitulate, parasitic fungi injure their host-plants by (1) depriving them of nourishment; (2) impairing the power of assimilation; (3) abnormally accelerating or retarding growth, causing distortion; (4) not only green parts are affected, but roots, stems, inflorescence, flowers, and fruit; (5) leaves and fruit fall prematurely; (6) decay is produced in ripe fruits before and after removal from the plant; (7) valuable plants receive injury from those of less value by ordinary infection or heterœcism.

The amount of injury due to one cause is uncertain, since several act together.

Certain groups of phanerogams are liable to be attacked by certain groups of fungi.—*A. B. Seymour, Cambridge, Mass.*